(WO/2008/140065) EMULSION-CONTAINING COMPOSITION, AND METHOD OF PREVENTING COAGULATION OF POLYPHENOL COMPOUND

書誌情報 | 明細書 | 請求の範囲 | 国内段階 | 更新情報 | 書類

注: OCR文書

WO 2008140065 20081120

DESCRIPTION

EMULSION-CONTAINING COMPOSITION, FOOD AND TOPICAL PRODUCT, AND METHOD OF PREVENTING COAGULATION OF POLYPHENOL COMPOUND

TECHNICAL FIELD

[0001] The present invention concerns an emulsion-containing composition, a food, a topical product, and a method of preventing coagulation of a polyphenol compound. In an embodiment, it particularly relates to an emulsion-containing composition, a food and a topical product containing catechins.

BACKGROUND ART ,

[0002] In recent years, functionality of catechins and fat-soluble ingredients such as carotenoids has attracted attention and various compositions containing both of these substances have been developed.

When catechins and fat-soluble ingredients are added to foods, topical products, and other processed products, the fat-soluble ingredients are added as highly dispersed emulsion compositions, and catechins are dissolved sufficiently and then added to the aqueous media to obtain emulsion-containing compositions.

[0003] However, when the catechin and the highly dispersed emulsion composition are mixed, and further when an organic acid is also present, the emulsion-containing composition sometimes causes precipitation, coagulation and separation, and a stable emulsion-containing composition cannot sometimes be obtained. For solving this problem, it has been tried to further improve the emulsion stability of the fat-soluble ingredient.

In recent years, the functionality of polyphenol compounds such as catechins or plant pigments has attracted attention, and various compositions containing such substances have been developed. The scope of polyphenol compound-containing compositions includes those obtained by previously mixing the respective ingredients including the polyphenol compound, as well as those obtained by previously preparing other ingredients than the polyphenol compound and then adding the polyphenol compound.

When using a fat-soluble material in the form of an emulsion together with a polyphenol compound, there is a problem in that the emulsion and the polyphenol compound tend to cause coagulation. For solving this problem, it has been tried to further improve the emulsion stability of the fat-soluble material.

[0004] For example, Japanese Patent No. 3298867 discloses a transparent composition which is a non-ethanol solubilized product in which a nonionic surfactant in a small amount

---- ten times the amount of the fat-soluble ingredient or less ---- is incorporated.

Further, Japanese Patent No. 3583331 discloses a nano-emulsion obtained by using a surfactant which is solid at a temperature of 45°C or lower and which is an ester or ether of a certain sugar. It is described that the nano-emulsion is stable during storage, shows good transparency, a favorable cosmetic property, good storage stability, and does not have

sticky feeling.

On the other hand, as examples of improvement in the emulsion stability by focusing on HLB, Japanese Patent No. 3492794 discloses a milk drink comprising a combination of a sucrose fatty acid ester having HLB of from 15 to 16 and enzymatically treated lecithin/enzymatically decomposed lecithin, and Japanese Patent Application Laid-Open (JP-A) No. 2000-245365 discloses a flavor composition comprising a combination of a sucrose fatty acid ester having HLB of from 16 to 19 and lysolecithin.

DISCLOSURE OF INVENTION

[0005] However, sufficient prevention of coagulation and precipitates in the emulsion-containing composition containing a catechin has not been achieved even by the techniques described above.

[0006] Further, sufficient emulsion stability against addition of the polyphenol compound has not been ensured by the techniques described above. Accordingly, when the polyphenol compound is added to the emulsion composition, coagulation of emulsion has not been prevented sufficiently.

Accordingly, it is an object of the present invention to provide an emulsion-containing composition containing a catechin or the like excellent in emulsion stability and free of coagulation or the like.

Another object of the present invention is to provide an emulsion composition excellent in emulsion stability that does not cause coagulation or the like even when combined with a polyphenol compound.

It is also an object of the present invention to provide a method of preventing coagulation, by which coagulation or the like is prevented when a polyphenol compound is included.

[0007] An emulsion-containing composition according to a first aspect of the invention contains (1) oil-in-water emulsion particles containing a fat-soluble ingredient and an emulsifier containing a sucrose fatty acid ester in which the fatty acid has less than 18 carbon atoms, and (2) a catechin. The emulsion-containing composition has a pH of from 2.5 to 6.5.

It is preferable that the emulsion composition further contains a polyglycerin fatty

acid ester, the degree of polymerization of glycerin in the polyglycerin fatty acid ester is 6 or less, and the number of carbon atoms of the fatty acid in the polyglycerin fatty acid ester is 14 or less.

The emulsion-containing composition according to the first aspect may further contain an organic acid as an acidulant and/or a pH controller, wherein the organic acid may be at least one acid selected from citric acid, gluconic acid, malic acid, and lactic acid.

Further, the fat-soluble ingredient preferably contains carotenoids, wherein the carotenoid is preferably astaxanthin and/or a derivative thereof.

[0008] The emulsion-containing composition according to the first aspect may further contain an antioxidant and, wherein the antioxidant preferably contains at least one member selected from ascorbic acids, ascorbic acid salts, derivatives thereof, tocopherols, and tocotrienols.

[0009] The food or the topical product according to the invention includes the emulsion composition described above. The food according to the invention may also be a packaged drink obtained by packing the emulsion-containing composition.
[0010] According to the first aspect, an emulsion-containing composition containing a catechin or the like may be provided which has excellent emulsion stability without occurrence of coagulation or the like.

[0011] The emulsion composition according to the second aspect of the invention contains a fat-soluble material, a

phospholipid, an emulsifier containing a sucrose fatty acid ester, and a (poly)glycerin fatty acid ester. The ratio of the amount of the (poly)glycerin fatty acid ester to the amount of the sucrose fatty acid ester is 0.1 or less by mass.

In the emulsion composition, the fat-soluble material may be a fat-soluble carotenoid, and the fat-soluble carotenoid may also be astaxanthin and/or an ester thereof.

In the emulsion composition, the number of carbon atoms in the fatty acid in the sucrose fatty acid ester is preferably from 12 to 18.

Further, the emulsion composition may further contain a polyhydric alcohol, and the polyhydric alcohol may be glycerin.

[0012] In the emulsion composition according to the second aspect, the transmittance of light at a wavelength of 700 nm is preferably 80% or higher when the content of the fat-soluble material is adjusted to 0.1 mass%.

Further, in the emulsion composition according to the second aspect, the particle diameter is preferably 200 nm or less.

The emulsion composition according to the second aspect is preferably a composition to be mixed with a polyphenol compound-containing solution.

[0013] The method of preventing coagulation of a polyphenol compound according to the invention is a method of preventing coagulation of the polyphenol compound in an emulsion composition containing (i) a fat-soluble material containing the polyphenol compound, (ii) a phospholipid, (iii) an emulsifier containing a sucrose fatty acid ester, and (iv) a (poly)glycerin fatty acid ester, in which the ratio of the amount of the (poly)glycerin fatty acid ester to the amount of the sucrose fatty acid ester is 0.1 or less by mass.

BEST MODE FOR CARRYING OUT THE INVENTION

[0014] An emulsion-containing composition according to a first embodiment contains (1) oil-in-water emulsion particles including a fat-soluble ingredient and an emulsifier containing a sucrose fatty acid ester whose fatty acid has less than 18 carbon atoms and (2) a catechin, wherein the pH of the emulsion-containing composition is from 2.5 to 6.5.

As described above, in the emulsion-containing composition according to the first embodiment, since the pH is within the predetermined range and a sucrose fatty acid ester having as a constituent component a fatty acid with less than 18 carbon atoms is included as an emulsifier for forming emulsion particles, occurrence of coagulation or the like can be suppressed effectively even when a catechin is present.

The first embodiment is to be described.

[0015] The emulsion-containing composition according to the first embodiment contains a catechin.

Catechins are included in flavonoids, which belong to a class of polyphenol, and in particular, in flavanols. In particular, (-) epicatechin, (-)epigallocatechin, (-)epicatechin gallate, (-)epigallocatechin gallate, etc. may be used alone or in combination as the catechins in the first embodiment. The catechins have been known as ingredients of tea. In particular, (-) epigallocatechin gallate has the highest content, and it occupies from 50 to 60% of catechins contained in tea. It is considered that, among the catechins, (-)epigallocatechin gallate has a wide variety of physiological activities including an antioxidant effect. Further, (-)epicatechin is contained also in polyphenols of apple, black berry, broad bean, cherry, grape, pear, raspberry, and chocolate besides tea, and can be used in the same manner. In addition, (+)-catechin (C, contained in polyphenols such as of broad bean, grape, apricot, and strawberry), catechin gallate (CG), (+)-gallocatechin (GC), (-)-gallocatechin gallate (GCG), etc. may also be included in the catechin according to the first embodiment. [0016] Examples of catechins include green tea extracts of THEA-FLAN 3 OA, manufactured by Ito En, Ltd. (polyphenol content: 30 mass% or more, EGCG content: 10 mass% or more), THEA-FLAN 90S (polyphenol content: 90 mass% or more, content of 8

types of catechin: 60 mass% or more, EGCG content: 40 mass% or more), Pharma Foods Tasty Catechin PF-TP 80 manufactured by Pharma Foods International Co., Ltd. (polyphenol content: 80 mass% or more, catechin content: 70 mass% or more), and PF-TP90 (polyphenol content: 90 mass% or more, catechin content: 80 mass% or more). [0017] A preferable content of catechin may be arbitrarily selected depending on the purpose. The catechin content is generally from 0.01 mass% to 1 mass%, preferably from 0.02 mass% to 0.8 mass% and, further preferably from 0.04 mass% to 0.8 mass%, with respect to the amount of the emulsion-containing composition. Substantial function of the catechin can be expected when the addition amount of catechin is 0.01 mass% or more. When the catechin content is 1 mass% or less, bitterness and astringency or the like can be controlled within a range that is appropriate for a drink, and a solution of an appropriate degree of coloration can be formed easily.

[0018] The emulsion-containing composition according to the first embodiment may contain an organic acid as an acidulant or a pH controller (which may be used for both purposes) from a viewpoint of keeping the quality and acidulation. The organic acid described above is not particularly limited, and preferable examples thereof include citric acid, trisodium citrate, gluconic acid, L-tartaric acid, malic acid, lactic acid, adipic acid, succinic acid, acetic acid and derivatives thereof, which may be used alone or as a combination of two or more of them. However, ascorbic acids, ascorbic acid salts and derivatives thereof are not excluded from the scope of the organic acid in the present disclosure. The organic acid as the acidulant and/or the pH controller is more preferably citric acid, gluconic acid, malic acid, lactic acid, or a derivative thereof.

The content of the organic acid in the emulsion-containing composition in the first embodiment is within a range of from 0.1 mass% to 1.5 mass% and, more preferably, within a range of from 0.5 mass% to 1.0 mass% with respect to the entire emulsion-containing composition.

[0019] The emulsion particles including the fat-soluble ingredient and the after-mentioned emulsifier in the first embodiment are not particularly limited so long as they are contained in the emulsion-containing composition. The emulsion particles are preferably incorporated in the emulsion-containing composition through production of the emulsion-containing composition according to the first embodiment by blending a liquid component containing a catechin and an oil-in-water emulsion composition containing the emulsion particles. The emulsion particles in the first embodiment mean the oil droplets in the oil in-water emulsion.

When blending the liquid component containing the catechin and the oil-in-water emulsion composition, the blending can be conducted such that amount of the oil-in-water

emulsion composition is from 0.5 mass% to 20 mass% and, more preferably, from 0.1 mass% to 10 mass%, with respect to the entire emulsion-containing composition. This range is preferable since an oil-in-water emulsion composition content of 0.5 mass% or more allows formation of an emulsion-containing composition having the function deriving from the fat-soluble ingredient and an oil-in-water emulsion composition content of 20 mass% or less allows control of the liquid property, taste such as sour taste, and flavor of the emulsion-containing composition.

The oil-in-water emulsion composition described above preferably contains the fat-soluble ingredient and the after-mentioned emulsifier.

[0020] Fat-soluble carotenoids may be mentioned as preferable examples of the fat-soluble ingredient.

The amount of carotenoid in the first embodiment is preferably from 0.1 to 10 mass%, more preferably from 0.1 to 5 mass% and, further preferably from 0.2 to 2 mass%, with respect to the amount of the emulsion composition from viewpoints of reduction in the emulsion particle diameter and emulsion stability.

[0021] Preferable examples of carotenoids in the first embodiment include carotenoids containing natural pigments, including pigments of yellow to red terpenoids derived from plants, algae and bacteria.

Further, carotenoids in the first embodiment are not limited to naturally-derived ones, and any of those obtained by common methods are also usable. For example, many of carotens of the after-mentioned carotenoids are produced also by synthesis, and many of commercial β-carotens are produced by synthesis.

[0022] The emulsion composition according to the second embodiment includes a fat-soluble material, a phospholipid, an emulsifier containing a sucrose fatty acid ester, and a (poly)glycerin fatty acid ester in a ratio of 0.1 or less by weight relative to the sucrose fatty acid ester.

The emulsion composition according to the second embodiment shows good emulsion stability and does not cause coagulation of emulsions even when it is combined with a polyphenol compound.

[0023] From a viewpoint of emulsifying power, the emulsifier in the second embodiment has HLB of preferably 10 or more, more preferably 12 or more. When the HLB value is excessively low, the emulsifying power is insufficient in some cases.

HLB means a balance of hydrophilicity-hydrophobicity used usually in the field of surfactants, and a commonly used calculation formula, for example, Kawakami's formula can be used. Kawakami's formula is shown below.

in which M_w is the molecular weight of hydrophilic group(s) and M_0 is the molecular weight of hydrophobic group(s).

Numerical values of HLB described in catalogs, etc. may also be used.

Further, as can be seen from the formula, an emulsifier having an arbitrary HLB value can be obtained by utilizing the additive property of HLB.

[0024] The emulsifier in the second embodiment includes a sucrose fatty acid ester. In the sucrose fatty acid ester used in the second embodiment, the number of carbon atoms in the fatty acid in the sucrose fatty acid ester is preferably from 12 to 18, more preferably from 14 to 16, and most preferably 14. A fatty acid carbon number of 12 or more is preferable in that sufficient emulsion stability can be ensured easily even in the emulsion composition not containing the (poly)glycerin fatty acid ester. A fatty acid number of 18 or less is preferable in that coagulation of the emulsion in the co-presence of polyphenol can be prevented. [0025] Preferable examples of the sucrose fatty acid ester in the second embodiment include sucrose monooleate ester, sucrose monostearate ester, sucrose monopalmitate ester, sucrose monomyristate ester, and sucrose monolaurate ester. In the second embodiment, either a single sucrose fatty acid ester or a mixture of two or more sucrose fatty acid esters may be used.

Commercial products include, for example, Ryoto Sugar Esters S-1170, S-1170F, S-1570, S-1670, P-1570, P-1670, M-1695, O-1570, OWA-1570, L-1695, and LWA-1570, manufactured by Mitsubishi-Kagaku Foods Corp., and DK esters SS, F160, F140, F110, F90, and Cosmelike S-110, S-160, S-190, P-160, M-160, L-160, L-150A, L-160A, and O-150, manufactured by Daiichi Kogyo Seiyaku Co., Ltd.

[0026] Further, in the emulsion composition according to the second embodiment, another emulsifier may also be used together. The emulsifier that can be used together is not particularly limited so long as the emulsifier is soluble in aqueous media, and nonionic emulsifiers are preferable since they are less stimulating and cause less effect on environments. Examples of nonionic emulsifiers include organic acid monoglyceride, propylene glycol fatty acid ester, polyglycerin condensed ricinoleate ester, sorbitan fatty acid ester, and polyoxyethylene sorbitan fatty acid ester. Preferable ones include sorbitan fatty acid esters and polyoxyethylene sorbitan fatty acid esters. Further, the emulsifiers are not necessarily highly purified products obtained, for example, by distillation, and may be reaction mixtures.

[0027] In the emulsion composition according to the second embodiment, the total amount of the glycerin fatty acid ester and the polyglycerin fatty acid ester (they are collectively

referred to as "(poly)glycerin fatty acid ester" in the present specification) among the emulsifiers described above is in a ratio of 0.1 or less by mass relative to the amount of the sucrose fatty acid ester. By setting the content of the (poly)glycerin fatty acid ester to 0.1 or less relative to the content of the sucrose fatty acid ester, coagulation of the polyphenol compound can be prevented without deteriorating the emulsion stability of the polyphenol compound.

The mass ratio of the (poly)glycerin fatty acid ester to the sucrose fatty acid ester may be 0.1 or less. From a viewpoint of preventing coagulation of the polyphenol compound more reliably, the ratio is preferably 0.05 or less, more preferably 0.001

or less, and most preferably 0. That is, it is most preferable that the (poly)glycerin fatty acid ester is not contained.

[0028] The content of the sucrose fatty acid ester in the second embodiment is preferably from 0.1 to 40 mass%, more preferably from 1 to 30 mass%, and further preferably from 5 to 20 mass%, with respect to the emulsion composition. A content of 0.1 mass% or more allows effective formation of an emulsion composition having a fine particle diameter and maintenance of satisfactory emulsion stability even when a polyphenol is added. A content of 40% mass% or less allows appropriate suppression of foaming of the emulsion composition.

When using another emulsifier together, the total amount of such an additional surfactant and the sucrose fatty acid ester may be within the range described above. When the additional emulsifier is used, the content ratio of the additional emulsifier is preferably 50 mass% or less, more preferably 30 mass% or less, with respect to the total amount of the emulsifiers in order to ensure the effects according to the second embodiment. [0029] The fat-soluble material in the second embodiment is not particularly limited, and examples thereof include fat-soluble carotenoids, fat-soluble vitamins, ubiquinones, and oils and fats and. Among them, fat-soluble carotenoids are preferable.

The amount of the fat-soluble material in the second embodiment is preferably from 0.1 to 30 mass%, more preferably from 1 to 20 mass%, and further preferably from 5 to 15 mass%, with respect to the amount of the emulsion composition from viewpoints of reduction in the emulsion particle diameter and the emulsion stability.

[0030] Preferable examples of carotenoids in the second embodiment include carotenoids containing natural pigments, including pigments of yellow to red terpenoids derived from plants, algae and bacteria.

Further, carotenoids in the second embodiment are not limited to naturally-derived ones, and any of those obtained by common methods are also usable. For example, many of

carotens of the after-mentioned carotenoids are produced also by synthesis, and many of commercial β -carotens are produced by synthesis.

[0031] In the invention (including both of the first and the second embodiments), examples of carotenoids include hydrocarbons (carotenes) and oxidized alcohol derivatives thereof

(xanthophylls).

Examples of thereof include actinioerythrol, astaxanthin, bixin, canthaxanthin, capsanthin, capsorubin, β-8'-apo-carotenal (apocarotenal), β-12'-apo-carotenal, α-carotene, β-carotene, "carotene" (mixture of α- and β-carotenes), γ-carotene, β-cryptoxanthin, echinenone, lutein, lycopene, violaxanthin, and zeaxanthin; esters of a hydroxyl- or carboxyl- containing carotenoid selected therefrom are also included.

[0032] Although many carteniods are present in the form of cis and trans isomers in the nature, synthetic products are often racemic mixtures.

Carteniods can generally be extracted from plant materials. Such carteniods have various functions and, for example, lutein extracted from petals of Tagetes genus is used widely as a raw material for fowl feeds and have a function of coloring skins and fats of fowls and eggs laid by fowls.

[0033] The carotenoid used in the invention is preferably oily at a normal temperature from a viewpoint of making the emulsion particle diameter finer. Particularly preferable examples may include at least one member selected from astaxanthin and astaxanthin derivatives such as esters of astaxanthin (these are hereinafter referred to collectively as "astaxanthins") having an antioxidant effect, anti-inflammatory effect, anti-skin aging effect, whitening, etc. and known as colorants within a range of from yellow to red.

Astaxanthins extracted from natural materials by using a supercritical carbon dioxide gas are more preferable in view of

odors.

[0034] Astaxanthin is a red pigment having an absorption maximum at 476 nm (ethanol) and 468 nm (hexane) and belongs to xanthophylls, which are one class of carotenoids (Davies, B.H.: In "Chemistry and Biochemistry of Plant Pigments", T. W. Goodwin ed., 2nd ed. 38-165, Academic Press, NY, 1976.). The chemical structure of astaxanthin is 3,3'-dihydroxy-β, β-carotene-4,4'-dione ($C_{40}H_{52}O_4$, molecular weight: 596.82). [0035] Astaxanthin includes three types of isomers ---- 3 S, 3 S ' form, 3 S, 3R' -form (meso-form), and 3R, 3R'-form ---- depending on the steric configuration of the hydroxyl groups at 3(3')-position of the ring structure present at both terminals of a molecule. Further, cis- and trans- isomers are present due to the conjugated double bonds at the center of the molecule; there are, for example, all-cis form, 9-cis form, and 13 -cis form.

[0036] The hydroxyl group at the 3(3')-position can form an ester with a fatty acid. The astaxanthin obtained from krill is a diester bonded to two fatty acids (Yamaguchi, K., Miki, W., Toriu, N., Kondo, Y., Murakami, M., Konosu, S., Satake, M., Fujita, T.: The composition of carotenoid pigments in the antarctic krill Euphausia superba, Bull. Jap. Soc. Sci. Fish., 1983, 49. p. 1411-1415). The astaxanthin obtained from H.pluvialis takes a 3S,3S'~form and contains much mono-ester form bonded to one fatty acid (Renstrom, B., Liaaen- Jensen, S.: Fatty acids of some esterified carotenols, Comp. Biochem. Physiol. B. Comp. Biochem., 1981, 69, p. 625-627).

[0037] Further, the astaxanthin obtained from Phaffia Rhodozyma takes 3R,3R'-form (Andrewes, A. G., Starr, M.P.: (3R,3 'R)-Asitaxanthin from the yeast Phaffa rhodozyma, Phytochem, 1976, 15, p.1009-1011), which is the opposite structure to the 3S,3S'-form usually found in the nature. Further, this is present in a free-form not forming an ester with a fatty acid (Andrewes, A.G., Phaffia, H.J., Starr, M.P.: Carotenids of Phaffia rhodozyma, a red pigmented fermenting yeast, Phytochem. 1976, 15, p.1003-1007).

[0038] Astaxanthin and esters thereof were separated first from lobster (Astacus gammarus L.) by R. Kuhn, and the estimated structure was disclosed (Kuhn, R., Soerensen, N. A.: The coloring matters of the lobster (Astacus gammarus L.), Z. Angew. Chem., 1938, 51, p.465-466). Since then, it has been made clear that astaxanthin distributes widely in the natura world and is usually present as an astaxanthin fatty acid ester form, and present also as an astaxanthin protein (Ovorubin, crustacyanin) bonded to protein in crustacean, etc. (Cheesman, D.F.: Ovorubin, a chromoprotein from the eggs of the gastropod mollusc Pomacea canaliculata. Proc. Roy. Soc. B, 1958, 149, p. 571-587).

[0039] The astaxanthin and esters thereof (astaxanthins) may be contained in the emulsion composition according to the invention as an astaxanthin-containing oil separated and extracted from natural products containing astaxanthin and/or esters thereof. Examples of the astaxanthin-containing oil include extracts from cultures of Phaffia Rhodozyme, green algae Haematococcus, marine bacteria, etc., and extracts from Antarctic Krill.

It is known that the Haematococcus algae extracts (pigments derived from Haematococcus green algae) are different, in the types of esters and contents thereof, from pigments derived from Krill and synthesized astaxanthins.

[0040] Astaxanthins usable in the invention may be extracts described above or those obtained by appropriately purifying the above extracts in accordance with necessity or synthesized products. Among astaxanthins, those extracted from Haematococcus algae (hereinafter also referred to as Haematococcus algae extracts) are particularly preferable in view of quality and productivity.

[0041] Origins of Haematococcus algae extracts usable in the invention include, specifically, Haematococcus pluvialis, Haematococcus lacustris, Haematococcus capensis, Haematococcus droebakensis, Haematococcus zimbabwiensis, etc.

For the culture method of Haematococcus algae usable in the invention, various methods disclosed, for example, in JP-A No. 8-103288 can be adopted with no particular restriction, so long as a morphological change from vegetative cells to cyst cells as dormant cells occurs.

[0042] Haematococcus algae extracts usable in the invention may be obtained from the starting materials described above. A method described, for example, in JP-A No. 5-68585 may be applied in accordance with necessity which includes pulverizing cell walls and conducting extraction through addition of an organic solvent such as acetone, ether, chloroform,

and alcohol (ethanol, methanol, etc.) or an extracting solvent such as carbon dioxide in a supercritical state.

The Haematococcus algae extracts contain, similarly to the pigment described in JP-A No. 2-49091, astaxanthin and/or an ester form thereof as a pure pigment ingredient, and the proportion of the ester form is generally 50 mol% or more, preferably 75 mol% or more, and more preferably 90 mol% or more.

Further, general marketed Haematococcus algae extracts can also be used in the invention, and examples thereof include ASTOTS-S, -2.5O, -50, -10O. manufactured by Takedashiki Co. Ltd., AstaReal oil 5OF, 5F, etc. manufactured by Fuji Chemical Industry Co. Ltd., and BioAstinSCE7 manufactured by Toyo Koso Kagaku Co. Ltd.

In the invention, the content of the astaxanthins as a pure pigment content in the Haematococcus algae extract is preferably from 0.001 to 50 mass%, more preferably from 0.01 to 25 mass% from a viewpoint of extraction cost.

[0043] Other fat-soluble ingredients in the emulsion composition include, for example, fat-soluble vitamins such as retinoids and vitamins D, ubiquinones such as coenzymes QlO, ω-3 oils and fats such as linolenic acid, eicosapentaenoic acid (EPA) docosahexaenoic acid (DHA), and fish oils containing such ω-3 oils and fats, and liquid oils and fats such as olive oil, camellian oil, macadamia nuts oil, castor oil, avocado oil, evening primrose oil, turtle oil, corn oil, mink oil, rapeseed oil, yolk oil, sesame oil, persic oil, wheat germ oil, sasanqua oil, linseed oil, safflower oil, cotton seed oil, perilla oil, soybean oil, peanut oil, tea seed oil, kaya oil, rice bran oil, Chinese rung oil, Japanese tung oil, jojoba oil, germ oil, triglycerin, glycerin trioctanoate, glycerin tmsopalitmate, salad oil, safflower oil (ref carthanus oil), palm oil, coconut oil, peanut oil, almond oil, hazelnut oil, walnut oil, grape seed oil, squalene, and squalane.

[0044] Ubiquinones include, for example, coenzymes Q such as coenzyme QlO. Coenzyme QlO is one of the coenzymes described in Japanese Pharmacopoeia as "ubidecarenone", and is also referred to as ubiquinone 10, coenzyme UQlO, etc. They are contained at a high content in natural products such as yeast, scomber, sardine and wheat germ in the natural world, and coenzyme QlO can be extracted by using a solvent such as hot water, hydrate alcohol, acetone, etc. They can also be produced industrially, for which a fermentation method or synthesis method is generally known. The coenzyme QlO used in the second embodiment may be either extracted from a natural material or synthesized industrially. Further, the coenzyme QlO may also be a commercially available product, and examples thereof coenzyme QlO manufactured by Nisshin Pharma Inc. and coenzyme QlO powder manufactured by NOF corporation.

[0045] Examples of fat-soluble vitamins include fat-soluble vitamins E, retinoids, vitamins D, and fat-soluble derivatives of ascorbic acid and erythorbic acid. Among them, fat-soluble vitamins E having a high antioxidant function and usable also as a radical scavenger are preferable.

The fat-soluble vitamins E are not particularly limited. and include, for example, tocopherol, tocotrienol, and derivatives thereof. Examples of the fat-soluble vitamins E include tocopherol and derivatives thereof such as dl-α-tocopherol, dl-β - tocopherol, dl-γ-tocopherol, dl-δ-tocopherol, acetic acid-dl-α-tocopherol, nicotinic acid-dl-α-tocopherol, linoleic acid-dl-α-tocopherol, and succinic acid-dl-α-tocopherol, α-tocotorienol, β-tocotorienol, γ-tocotorienol, and δ-tocotorienol. Either a single fat-soluble vitamin E or a combination of plural fat-soluble vitamins E may be used. It is preferable to use a mixture of fat-soluble vitamins E, and example of the mixture include those referred to as extracted tocopherols or mix tocopherols.

[0046] Examples of the retinoids include vitamins A such as retinol, 3-hydroretinol, retinal, 3-hydroretinal, retinoic acid, 3-dehydro retinoic acid, and vitamin A acetate; and provitamins A such as carotenoids (e.g., α-, β-, and γ- carotens, β-cryptoxanthin, and echinenone) and xanthophylls. Examples of the vitamins D include vitamin D_2 to vitamin D_7.

Further, other examples of fat-soluble vitamin materials include vitamin esters such as vitamin E nicotinate, and vitamins K such as vitamin K_1 to vitamin K_3.

Oil-solubilized derivatives of ascorbic acid, erythorbic acid, and the like include fatty acid esters of vitamin C such as L-ascorbyl stearate, L-ascorbyl tetraisopalmitate, L-ascorbyl palmitate. erythorbyl palmitate, erythorbyl tetraisopalmitate, and ascorbyl dioleate, and fatty acid esters of vitamin B_6 such as pyridoxine dipalmitate, pyridoxine tripalmitate, pyridoxine

dilaurate and pyridoxine dioctanoate. Among them, the oil-solubilized derivatives of ascorbic acid and erythorbic acid can be used also as radical scavengers. [0047] ω-3 oils and fats include, for example, linolenic acid, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), and fish oils containing them.

Among them, DHA is an abbreviation of Docosahexaenoic acid which is a collective name of carboxylic acids (22:6) having a C_{22} carbon chain containing six double bonds, and usually has cis- double bonds at all of 4,7,10,13,16,19 positions, which are important for living bodies.

[0048] In addition to ω-3 oils and fats, other oils and fats which are liquid (fatty oils) or solid (fats) at a normal temperature may be also mentioned.

The liquid oils and fats include, for example, olive oil, camellia oil, macadamia nuts oil, castor oil, avocado oil, evening primrose oil, turtle oil, corn oil, mink oil, rapeseed oil, yolk oil, sesame oil, persic oil, wheat germ oil, sasanqua oil, linseed oil safflower oil, cotton seed oil, perilla oil, soybean oil, peanut oil, tea seed oil, kaya oil, rice bran oil, Chinese tung oil, Japanese tung oil, jojoba oil, germ oil, triglycerin, glycerin trioctanoate, glycerin trisopalitmate, salad oil, safflower oil (ref carthanus oil), palm oil, coconut oil, peanut oil, almond oil, hazelnut oil, walnut oil, grape seed oil, squalene, squalane.

Further, the solid oils and fats include beef tallow, hydrogenated beef tallow, neat's-foot tallow, beef bone tallow, mink oil, egg yolk oil, lard, horse fat, mutton tallow, hydrogenated oil, cacao fat, coconut oil, hydrogenated coconut oil, palm oil, hydrogenated palm oil, Japan wax, Japan wax kernel oil, and hydrogenated castor oil.

Among them, it is preferable to use coconut oil, which is a medium chain fatty acid triglyceride, from viewpoints of the particle diameter and the stability of the emulsion composition.

[0049] Further, other fat-soluble materials include, for example, hydrocarbons such as liquid paraffin, paraffin, Vaseline, ceresin and microcrystalline wax; waxes such as carnauba wax, candellia wax, jojoba oil, bees wax and lanolin; esters such as isopropyl myristate, 2-octyldedecyl myristate, cetyl 2-ethylhexanoate and diisostearyl malate; fatty acids such as palmitic acid, stearic acid, isostearic acid, linoleic acid and arachidonic acid; higher alcohols such as cetyl alcohol, stearyl alcohol, isostearyl alcohol and 2-octyldodecanol; silicone oils such as methyl polysiloxane and methylphenyl polysiloxane; polymers, fat-soluble colorants, fat-soluble proteins, and various plant-derived oils and animal-derived oils, which are mixtures of substances selected from the above substances. [0050] The phospholipid in the second embodiment includes a glycerin or sphingosine skeleton, a fatty acid residue, and a phosphoric acid residue as essential constituent

components, to which a base, a polyhydric alcohol, or the like may be bonded. [0051] The emulsion composition according to the first embodiment contains as an emulsifier a sucrose fatty acid ester in which the fatty acid has less than 18 carbon atoms. When the sucrose fatty acid ester in which the fatty acid has less than 18 carbon atoms is used, a stable emulsion composition with no occurrence of coagulation or precipitation can be provided even when the emulsion composition contains a catechin. From a viewpoint of effectively preventing the occurrence of coagulation or the like, the sucrose fatty acid ester in the emulsion composition according to the first embodiment preferably has 12 to 16 carbon atoms and, more preferably has 12 to 14 carbon atoms.

Examples of such sucrose fatty acid esters include sucrose butyrate, sucrose caproate, sucrose caprylate, sucrose caprate, sucrose laurate, sucrose myristate, and sucrose palmitate. Among them, sucrose laurate, sucrose myristate, and sucrose palmitate are preferable. In the first embodiment, either a single sucrose fatty acid ester or a mixture of plural sucrose fatty acid esters may be used. The following may be mentioned as commercial products: for example, Ryoto sugar esters P-070, P-170, P- 1570, P-1670, M-1695, L- 195, L-595, L-1695, and LWA-1570 manufactured by Mitsubishi Kagaku Foods Corp., and Cosmelike P-160, M-160, L-10, L-50, L-160, L-150A, and L-160A manufactured by Daiichi Kogyo Seiyaku Co., Ltd. They may be used alone or in combination of two or more of them. [0052] The blending amount of the sucrose fatty acid ester is preferably from 0.1 to 50 mass%, more preferably from 0.5 to 20 mass%, and further preferably from 1 to 15 mass%, with respect to the amount of the emulsion composition. When the blending amount of the sucrose fatty acid ester is 0.1 mass% or more, an emulsion with a fine particle diameter can be obtained and the stability of the emulsion can be sufficient. On the other hand, when the blending amount of the sucrose fatty acid ester is 50 mass% or less, foaming of the emulsion can be suppressed appropriately.

[0053] Further, in the emulsion composition according to the first embodiment, another emulsifier may also be used together. The emulsifier that can be used together is not particularly limited so long as the emulsifier is soluble in an aqueous medium, and is preferably a nonionic emulsifier since it has less stimulating property and exerts less adverse effects on environment. Examples of the nonionic emulsifier include organic acid monoglycerides, propylene glycol fatty acid esters, polyglycerin condensed ricinoleate esters, sorbitan fatty acid esters, and polyoxyethylene sorbitan fatty acid esters. Sorbitan fatty acid esters and polyoxyethylene sorbitan fatty acid esters are more preferable. The emulsifier is not necessarily a highly purified product obtained by distillation or the like, and may be a reaction mixture.

[0054] When using a glycerin fatty acid ester in the emulsion composition according to the first embodiment, the glycerin fatty acid ester is preferably a polyglycerin fatty acid ester having a glycerin polymerization degree of 6 or less wherein the number of carbon atoms in the fatty acid in the ester is 14 or less. Such a glycerin fatty acid ester can effectively prevent coagulation or the like in the emulsion composition without deteriorating the emulsion stability of the polyphenol compound even when the emulsion composition contains a catechin. The degree of polymerization of glycerin is more preferably from 4 to 6, and most preferably from 4 to 6, from a viewpoint of the stability of the emulsion composition containing a catechin. Further, the number of carbon atoms in the fatty acid is more preferably from 8 to 14 from a viewpoint of the stability. Examples of such polyglycerin fatty acid esters include tetraglycerin caprylate, hexaglycerin caprylate, hexaglycerin caprate, hexaglycerin laurate, and hexaglycerin myristate. Hexaglycerin laurate, hexaglycerin myristate, and tetraglycerin caprylate are preferable from a viewpoint of the emulsion stability of the emulsion composition.

When a mono- or polyglycerin fatty acid ester is contained, the amount thereof can be from 0.1 mass% to 50 mass%, and more preferably from 0.5 mass% to 20 mass%, with respect to the emulsion composition, from viewpoints of emulsion stability and coagulation prevention of the emulsion composition.

[0055] From a viewpoint of emulsifying power, the emulsifier in the first embodiment has a HLB of preferably 10 or more, more preferably 12 or more. When the HLB value is excessively low, the emulsifying power is insufficient in some cases.

HLB means a balance of hydrophilicity-hydrophobicity used usually in the field of surfactants, and a commonly used calculation formula, for example, Kawakami's formula can be used. Kawakami's formula is shown below.

$HLB=7+11.7 \log (M_w/M_o)$ in which M_w is the molecular weight of hydrophilic group(s) and M_o is the molecular weight of hydrophobic group(s).

Numerical values of HLB described in catalogs, etc. may also be used.

Further, as can be seen from the formula, an emulsifier having an arbitrary HLB value can be obtained by utilizing the additive property of HLB. [0056] The emulsion composition according to the first embodiment may contain a phospholipids as an emulsifier. The phospholipid includes a glycerin or sphingosine skeleton, a fatty acid residue, and a phosphoric acid residue as essential constituent components, to which a base, a polyhydric alcohol, or the like may be bonded. [0057] In the invention encompassing the first and the second embodiments, usable

phospholipids include, for example, glycerolecithins such as lecithin (phosphatidylcholine), phosphatidic acid, bisphosphatidic acid, phosphatidyl ethanolamine, phosphatidyl methylethanolamine, phosphatidyl serine, phosphatidyl inositol, phosphatidyl glycerin, and diphosphatidyl glycerin (cardiolipin), and sphingolecithins such as sphingomyelin. Also include are various kinds of lecithins containing the ingredients described above, which may be derived from plants such as soybean, corn, peanut, rapeseed, and wheat, from animals such as yolk and cattle, and from microorganisms such as Escherichia coli. While the origins of the phospholipids are not limited, purified ingredients are particularly suitable. In the invention, either a single phospholipid or a combination of plural phospholipids may be used.

Among the phospholipids, lecithin (phosphatidyl choline) is preferable in view of easy availability, safety and emulsifying property.

[0058] Since the lecithin has a hydrophilic group and a hydrophobic group in the molecule, it has been used as an emulsifier widely in the field of foods, medicines and cosmetics. Materials having a lecithin purity of 60% or higher are utilized

industrially, and they may be utilized also in the invention. Those generally referred to as highly pure lecithin are preferable from viewpoints of realizing small oil droplet diameter and stability of the fat-soluble ingredient, wherein the highly pure lecithin have a lecithin purity of 80 mass% or more, more preferably 90 mass% or more.

[0059] Examples of the lecithin include various types of conventionally known lecithins extracted and separated from living bodies of plants, animals and microorganisms. Commercial products of lecithin include LECION series and LECIMAL EL manufactured by Riken Vitamin Co., Ltd.

[0060] In the invention, usable lecithins are not limited to the highly pure lecithins, and the following are also usable: hydrogenated lecithins, enzymatically decomposed lecithins, enzymatically decomposed hydrogenated lecithins, hydroxy lecithins and the like. Such hydrogenated or hydroxylated lecithins are particularly preferable for cosmetics applications. The hydrogenation is conducted, for example, by reacting lecithin with hydrogen in the presence of a catalyst whereby one or more unsaturated bonds in the fatty acid portion are hydrogenated. The hydrogenation improves the oxidation stability of lecithin.

The enzymatically decomposed lecithin is also referred to as lysolecithin; lysolecithin has an improved hydophilicity and is obtained by allowing phospholipase A2 to act on lecithin and hydrolyze the ester bond at the β-position, so as to increase the number of hydroxyl groups.

Further, the hydroxylation may be achieved by the following process: lecithin is heated with hydrogen peroxide at high concentration and an organic acid such as acetic acid,

tartaric acid, or butyric acid, resulting in hydroxylation of one or more unsaturated bonds in the fatty acid portion. The hydroxylation improves the hydrophilicity of lecithin.

Such phospholipids usable in the invention may be used alone or in the form of a mixture of plural kinds of phospholipids.

[0061] In the invention, either a single phospholipid or a mixture of plural phospholipids may be used.

In the emulsion composition according to the invention, the content of the phospholipid is preferably from 0.1 to 10 mass%, more preferably from 0.2 to 8 mass%, and further preferably from 0.5 to 5 mass%.

When the content of the phospholipid is 0.1 mass% or more, the emulsion stability of the emulsion composition tends to be improved. Further, when the content is 10 mass% or less, formation of a phospholipid dispersion in water through separation of excessive phospholipid from the fat-soluble ingredient does not occur, which is preferable in view of the emulsion stability of the emulsion composition.

[0062] When another emulsifier is used together with the sucrose fatty acid ester in the emulsion composition according to the first embodiment, the total amount of such an additional emulsifier and the sucrose fatty acid ester may be within the range described above. In this case, the proportion of the additional emulsifier is preferably 50 mass% or less, more preferably 30 mass% or less, with respect to the total amount of the emulsifiers, in order to ensure the effects according to the first embodiment.

[0063] The emulsion composition according to the first embodiment preferably contains a polyhydric alcohol from viewpoints of further reducing the emulsion particle diameter and maintaining the small particle diameter stably for a long time.

[0064] The polyhydric alcohol in the second embodiment has functions such as moisture keeping function and viscosity controlling function. Further, the polyhydric alcohol also has a function of lowering the interfacial tension between water and the oil and fat ingredient, promoting the interface to spread, and facilitating formation of fine and stable particles. [0065] The polyhydric alcohol in the invention (including the first and second embodiments) is not particularly limited. Examples thereof include glycerin, diglycerin, triglycerin, polyglycerin, 3-methyl-1,3-butanediol, 1,3-butylene glycol, isoprene glycol, polyethylene glycol, 1,2-pentanediol, 1,2-hexane diol, propylene glycol, dipropylene glycol, polypropylene glycol, ethylene glycol, diethylene glycol, pentaerythritol, neopentyl glycol, maltitol, reduced starch syrup, fructose, glucose, sucrose, lactitol,

palatinit, erythritol, sorbitol, mannitol, xylitol, xylose, glucose, lactose, mannose, maltose, galactose, fructose, inositol, peniaerythritol, maltotriose, sorbitol, sorbitan, trehalose, starch decomposed sugar, and starch decomposed

sugar reduced alcohol. Either a single polyhydric alcohol or a mixture of plural polyhydric alcohols may be used.

[0066] Further, the polyhydric alcohol is preferably a polyhydric alcohol having 3 or more hydroxyl groups in one molecule. Use of the polyhydric alcohol having 3 or more hydroxyl groups in one molecule may lead to effective reduction in the interfacial tension between an aqueous solvent and an oil and fat ingredient, and may lead to formation of finer and more stable particles. As a result, it is possible to further improve the intestinal absorption in a case of food application, and the transdermal absorption in a case of cosmetic application. [0067] In particular, use of glycerri, among the polyhydric alcohols satisfying the conditions described above, is preferable since it enables further reduction of the emulsion particle diameter o the emulsion and stable maintenance of the small particle diameter for a long time, and the coagulation preventing effects according to the first embodiment are exhibited most effectively.

[0068] The content of the polyhydric alcohol is preferably from 10 to 60 mass%, more preferably from 20 to 55 mass%, and further preferably from 30 to 50 mass%, with respect to the emulsion composition according to the first embodiment. At a polyhydric alcohol content of 10 mass% or more may realize a sufficient storage stability, irrespective of the type and the content of the fat-soluble ingredient. On the other hand, a polyhydric alcohol content of 60 mass% or less may achieve the desired effects with the viscosity of the emulsion composition adjusted within an appropriate range.

[0069] The content of the polyhydric alcohol is, preferably, from 10 to 60 mass%, more preferably, from 20 to 55 mass%, and, further preferably, from 30 to 50 mass% with respect to the composition according to the second embodiment. At the content of the polyhydric alcohol of 10 mass% or more, a sufficient storage stability can be obtained irrespective of the type and the content of the fat-soluble material. On the other hand, at the content of the polyhydric alcohol of 60 mass% or less, the aimed effect can be obtained while controlling the viscosity of the emulsion composition within an appropriate range. [0070] Further, the emulsion-containing composition according to the first embodiment preferably contains an antioxidant from a viewpoint of preventing oxidative degradation of the catechin, fat-soluble ingredient, and the like.

The content of the antioxidant in the emulsion-containing composition according to the first embodiment is generally from 0.1 to 10 mass%, preferably from 0.1 to 5 mass%, and more preferably from 0.2 to 2 mass%, from a viewpoint of effectively preventing the degradation of the catechin, fat-soluble ingredient, and the like.

In the first embodiment, when the antioxidant is contained in the

emulsion-containing composition, the antioxidant may be contained either in the oil phase or in the aqueous phase. However, from a viewpoint of a store stability of the fat-soluble ingredient (e.g., carotenoid), it is preferable that each of the aqueous phase and the oil phase contains at least one antioxidant. Further, so long as it is contained in the final emulsion-containing composition according to the first embodiment, the timing of addition is not particularly limited. The antioxidant may be contained in the emulsion composition, or in the liquid component to be mixed with the emulsion composition, or it may be added directly to the emulsion-containing composition.

[0071] The antioxidant used in the emulsion-containing composition according to the first embodiment is not particularly limited. Examples thereof include (a) a class of compounds composed of ascorbic acids, (b) a class of compounds composed of tocophenols, (c) a class of compounds composed of polyphenols, and (d) radical scavengers. The antioxidant may be a hydrophilic antioxidant and/or a fat-soluble antioxidant, and may be used alone or in combination of two or more antioxidants. For example, compounds belonging to class (a) of compounds may be mentioned as examples of the hydrophilic antioxidants, and compounds belonging to the class (b) of compounds may be mentioned as examples of the fat soluble antioxidants.

Specific examples of the classes (a) to (d) of compounds as antioxidants usable in the first embodiment are described below. However, the specific examples should not be construed as limiting the scope of the antioxidants usable in the first embodiment. [0072] (a) Class of Compounds Composed of Ascorbic Acids

Examples of ascorbic acid, ascorbic acid derivatives, or salts thereof include L-ascorbic acid, sodium L-ascorbate,

potassium L-ascorbate, calcium L-ascorbate, a L-ascorbic acid phosphate ester, a magnesium salt of a L-ascorbic acid phosphate ester, a L-ascorbic acid sulfate ester, a disodium salt of a L-ascorbic acid sulfate ester, and L-ascorbic acid 2-glucoside. Among them, L-ascorbic acid, sodium L-ascorbate, L-ascorbic acid 2-glucoside, a magnesium salt of a L-ascorbic acid phosphate ester, and a disodium salt of a L-ascorbic acid sulfate ester are particularly preferable.

[0073] As the antioxidants belonging to (a) ascorbic acids used for the first embodiment, commercially available products may be used appropriately. Examples thereof include L-ascorbic acid (manufactured, for example, by Takeda Pharmaceutical Co., Ltd., Fuso Chemical Co., Ltd., BASF Japan Ltd., or Dai-ichi Kogyo Seiyaku Co., Ltd.), sodium L-ascorbate (manufactured, for example, by Takeda Pharmaceutical Co., Ltd., Fuso Chemical Co., Ltd., BASF Japan Ltd., or Dai-ichi Kogyo Seiyaku Co., Ltd.), ascorbic acid 2-glucoside (for example, AA-2G manufactured by Hayashibara Biochemical Labs., Inc.), magnesium

L-ascorbate phosphate (for example, Ascorbic acid PM "SDK" (manufactured by Showa Denko KK), NIKKOL VC-PMG (manufactured by Nikko Chemicals Co. Ltd.), or C-mate (manufactured by Takeda Pharmaceutical Co., Ltd.)). [0074] (b) Class of Compounds Composed of Tocopherols

Tocopherols used in the emulsion composition according to the first embodiment are not particularly limited, and may be selected from the group consisting of a class of compounds composed of tocopherols and derivatives thereof.

The class of compounds composed of tocopherols and derivatives thereof include tocopherols and derivatives thereof, such as dl-α-tocopherol, dl-β -tocopherol, dl-γ-tocopherol, dl-δ-tocopherol, dl-α-tocopherol acetate, dl-α-tocopherol nicotinate, dl-α-tocopherol linoleate, dl-α-tocopherol succinate, and tocotrienols such as α-tocotrienol, β-tocotrienol, γ-tocotrienol, and δ-tocotrienol. They are often used in a state of a mixture, and can be used in a state referred to as an extracted tocopherol or a mix tocopherol.

The content of the tocopherol in the emulsion dispersion and/or the composition thereof in the first embodiment is not particularly limited. The ratio of the amount of the tocopherol to the amount of the emulsion composition is preferably in the range of from 0.1 to 5 by mass, more preferably from 0.2 to 3 by mass, and further preferably from 0.5 to 2 by mass. [0075] (c) Class of Compounds Composed of Polyphenols

The group of compounds composed of polyphenols include flavonoids (anthocyanin, flavon, isoflavon, flavan, flavanon, rutin), phenolic acids (chlorogenic acid, ellagic acid, gallic acid, propyl gallate), lignans, curcumins, and coumarins. Further, since such compounds are contained at high contents in the extracts derived from natural products, such as those described below, they can be used in the form of extracts.

[0076] Examples include licorice extracts, cucumber extracts, Mucuna birdwoodiana extracts, gentian (Gentiana triflora) extracts, Geranium thunbergii extracts, cholesterol and derivatives thereof, hawthorn extracts, peony extracts, ginkgo extracts, Baikal skullcap extracts, carrot extracts, Rugosa rose (Maikai) extracts, sanpenzu (cassia) extracts, torumentilla extracts, parsley extracts, Paeonia suffruticosa (Moutan Cortex.) extracts, Japanese quince extracts, Melissa extracts, alnus firma fruit extracts, strawberry geranium extracts, rosemary (mannennrou) extracts, lettuce extracts, tea extracts (oolong tea, black tea, green tea, etc.), microorganism fermentation metabolic products and Momordica grosvenorii extracts (terms in the brackets describe another name of plants and name of crude drags). Among the polyphenols, particularly preferable ones include catechin, rosemary extracts,

glucosyl rutin, ellagic acid and gallic acid.

[0077] As the antioxidants belonging to the class (c) of compounds used in the first embodiment, general commercially available products may be appropriately used. Examples thereof include ellagic acid (manufactured, for example, by Wako Pure Chemicals Industries Ltd., etc.), rosemary extracts (for example, RM-21A, RM-21E manufactured by Mitsubishi-Kagaku Foods Corp., etc.), sodium gallate (for example, SANKATOL manufactured by Taiyo Kagaku Co., Ltd., etc.), rutin, glucosyl rutin, enzymatically decomposed rutin (for example, RUTIN K-2, P-IO manufactured by Kiriya Chemical Co, Ltd, and αG Rutin manufactured by Hayashibara Biochemical Laboratories, Inc., etc.), and SANMELIN series products manufactured by San-Ei Gen F.F.I., Inc. [0078] (d) Class Composed of Radical Scavengers

A radical scavenger is an additive having a role of suppressing generation of radicals, scavenging generated radicals as soon as possible and disconnecting chain reaction (described in: "Abura-Kagaku Binran" (Handbook of Oil Chemistry), 4th Edition, edited by Japan Oil Chemist's Society, 2001).

As a method of directly confirming the function as the radical scavenger, a method has been known in which the substance to be tested is mixed with a reagent and the process of scavenging radicals is measured with a spectrophotometer or ESR (Electron Spin Resonance Instrument). In the method, DPPH (1,1-diphenyl-2-picryl hydrazyl) or a galvinoxyl radical may be used as the reagent.

In the first embodiment, a compound is considered to be a radical scavenger if the time required for the peroxide value (POV value) of an oil to rise to 60 meq/kg through auto-oxidation reaction of the oil under the following experimental condition is at least twice (more preferably at least five times) the time required for blank. Oil: Olive oil

Addition amount: 0.1 mass% to oil and fat

Test condition: Specimen is heated at 190^{0}C, a POV value is measured with time, and the time required until the POV value reaches 60 meq/kg is obtained.

[0079] Among various kinds of antioxidants described in Kajimoto "Kousankazaino Riron to Jissai" (Theory and Practice of antioxidant) (San Shobo, 1984) or Sawatari, Nishino, Tabata "Kousankazai Handbook" (Antioxidant handbook) (Taiseisha, 1976), those functioning as radical scavengers may be used as radical scavengers in the first embodiment. Examples thereof include, specifically, compounds having phenolic OH groups, amine-based antioxidants such as phenylene diamine and oil-solubilized derivatives of ascorbic acid and erythorbic acid.

While preferable compounds are illustrated below, the first embodiment is not limited thereto.

[0080] The compounds having the phenolic OH include guaiac gum, nordihydroguaiaretic acid (NDGA), gallate esters, BHT (butyl hydroxy toluene), BHA (butyl hydroxy anisol), tocopherols and bisphenols. The gallate esters include propoyl gallate, butyl gallate and octyl gallate. Particularly preferable are, at least one member selected from dibutyl hydroxy toluene, butyl hydroxy anisol, nordihydroguaiaretic acid, and tocopherols.

The amine-based compounds include phenylene diamine, and diphenyl-p-phenylene diamine or 4-ammo-p-diphenylamine is more preferable.

The oil-solubilized derivatives of ascorbic acid and erhthorbic acid include, for example, L-ascorbic acid stearate ester, L-ascorbyl tetraisopalmitate, L-ascorbic acid palmitate ester, erythorbic acid palmitate ester, erythorbyl tetraisopalmitate. [0081] Among the antioxidants, at least one member selected from tocopherols and tocotrienols is preferable from a viewpoint of the ability to prevent oxidation of carotenoids. [0082] While the method of producing the emulsion composition in the first embodiment is not particularly limited, it preferably includes, for example, steps of a) dissolving a water-soluble emulsifier and a hydrophilic antioxidant in an aqueous medium to obtain an aqueous phase, (b) mixing and dissolving a fat-soluble ingredient such as carotenoid, a fat-soluble emulsifier, a fat-soluble antioxidant and, optionally, another oil or fat to obtain an oil phase, and (c) mixing the aqueous phase and the oil phase under stirring to conduct dispersing emulsification, thereby obtaining an emulsion composition. [0083] While the ratio (by mass) of the oil phase to the aqueous phase during the dispersing emulsification is not particularly limited, the oil phase/aqueous phase ratio (mass%) is preferably in the range of from 0.1/99.9 to 50/50, more preferably from 0.5/99.5 to 30/70, and further preferably from 1/99 to 20/80.

An oil phase/aqueous phase ratio of 0.1/99.9 or more is preferable since the amounts of effective ingredients are not excessively small and, accordingly, the emulsion composition may have no practical problem. Further, an oil phase/aqueous phase ratio of 50/50 or less is preferable since the concentration of the surfactant is not excessively low and, accordingly, the emulsion stability of the emulsion composition may not be inferior. [0084] For the dispersing emulsification, a one-step emulsifying operation may be conducted; however an emulsifying operation having at least two steps is preferable from the standpoint of obtaining uniform and fine emulsified particles.

Specifically, it is particularly preferable to use two or more kinds of emulsifying apparatuses; for example, emulsification with a high-pressure homogenizer or the like may be

combined with a one-step emulsifying operation in which emulsification is conducted by using a usual emulsifying apparatus utilizing a shearing action (for example, a stirrer or an impeller agitation, a homo mixer, a continuous flowing type shearing apparatus, or the like). By the use of the high pressure homogenizer, the emulsion may include fine liquid droplet particles with further improved uniformity. Further, the operation may be conducted plural times in order to make the diameter of the liquid droplets more uniform. [0085] While the temperature condition at the time of the dispersing emulsification in the first embodiment is not particularly limited, it is preferably from 10 to 100°C from a viewpoint of the stability of the fat-soluble ingredient. A preferable range may be selected appropriately depending, for example, on the melting point of the fat-soluble ingredient to be used.

[0086] Examples of the high pressure homogenizer include a chamber type high pressure homogenizer having a chamber in which a flow path for the liquid to be treated is fixed and a homogenizing valve type high pressure homogenizer having a homogenizing valve. Among them, a homogenizing valve type high pressure homogenizer is preferable for the process for producing the emulsion composition according to the first embodiment since the width of the flow path of the liquid to be treated can be controlled easily, and the pressure and the flow rate during operation can be set arbitrarily, which broadens the operation range.

Further, although the degree of freedom for operation is low, the chamber type high pressure homogenizer can also be used suitably when a super high pressure is required; this is because a mechanism for increasing the pressure can be prepared easily. [0087] Examples of the chamber type high pressure homogenizer include a MICROFLUIDIZER (manufactured by Microfluidics Co.), NANOMIZER (manufacture by Yoshida Kikai Co., Ltd.), and ULTIMIZER (manufactured by Sugino Machine Ltd.).

Examples of the homogenizing valve type high pressure homogenizer include a Gaulin type homogenizer (manufactured by APV Co.), a Rannie type homogenizer (manufactured by Rannie Co.), a high pressure homogenizer (manufactured by Niro Soavi), a homogenizer (manufactured by Sanwa Machine Co. Inc.), a high pressure homogenizer (manufactured by Izumi Food Machinery Co. Ltd.), and a super high pressure homogenizer (manufactured by IKA Laboratories Co.)

[0088] In the first embodiment, the processing pressure in the high pressure homogenizer is preferably 50 MPa or higher, more preferably from 50 to 250 MPa, and further preferably from 100 to 250 MPa.

Further, from a viewpoint of maintaining the particle diameter of the dispersed particles, the emulsion liquid — an emulsified and dispersed composition — is preferably

cooled through a cooler within 30 sec, preferably within 3 sec, from passing the chamber. [0089] The emulsion composition obtained through the steps described above is an O/W emulsion in which emulsion particles (emulsified particles) containing the fat-soluble ingredient are dispersed in an aqueous medium.

In particular, in the first embodiment, an emulsion composition in which fine emulsion particles are dispersed uniformly can be obtained. [0090] (Process for Producing Water-in-Oil Emulsion)

The process for producing the emulsion composition in the second embodiment is not particularly limited. For example, a production process including the following steps is preferable: (a) dissolving an emulsifier in an aqueous medium (for example, water or a mixture of water and a polyhydric alcohol) to obtain an aqueous phase, (b) mixing and dissolving a fat-soluble material (for example, a fat-soluble carotenoid) and a phospholipid to obtain an oil phase and (c) mixing the aqueous phase and the oil phase under stirring and conducting dispersing emulsification to obtain an emulsion composition.

In the production process, the ingredients contained in the oil phase and the ingredients contained in the aqueous phase are the same as the constituent ingredients of the emulsion composition according to the second embodiment, and preferable examples and preferable amounts are also the same. The preferable combinations mentioned in the description on the constituent ingredients of the emulsion composition according to the second embodiment are also preferable in the production process.

[0091] While the ratio (by mass) of the oil phase to the aqueous phase during the dispersing emulsification is not particularly limited, the oil phase/aqueous phase ratio (mass%) is preferably in the range of from 0.1/99.9 to 50/50, more preferably from 0.5/99.5 to 30/70, and further preferably from 1/99 to 20/80.

An oil phase/aqueous phase ratio of 0.1/99.9 or more is preferable since the amounts of effective ingredients are not excessively small and, accordingly, the emulsion composition may have no practical problem. Further, an oil phase/aqueous phase ratio of 50/50 or less is preferable since the concentration of the surfactant is not excessively low and, accordingly, the emulsion stability of the emulsion composition may not be inferior. [0092] For the dispersing emulsification, a one-step emulsifying operation may be conducted; however an emulsifying operation having at least two steps is preferable from the standpoint of obtaining uniform and fine emulsified particles.

Specifically, it is particularly preferable to use two or more kinds of emulsifying apparatuses; for example, emulsification with a high-pressure homogenizer or the like may be combined with a one-step emulsifying operation in which emulsification is conducted by

using a usual emulsifying apparatus utilizing a shearing action (for example, a stirrer or an impeller agitation, a homo mixer, a continuous flowing type shearing apparatus, or the like). By the use of the high pressure homogenizer, the emulsion may include fine liquid droplet particles with further improved uniformity. Further, the operation may be conducted plural times in order to make the diameter of the liquid droplets more uniform. [0093] While the temperature condition at the time of the dispersing emulsification in the second embodiment is not particularly limited, it is preferably from 10 to 100°C from a viewpoint of the stability of the fat-soluble ingredient. A preferable range may be selected appropriately depending, for example, on the melting point of the fat-soluble ingredient to be used.

[0094] Examples of the high pressure homogenizer include a chamber type high pressure homogenizer having a chamber in which a flow path for the liquid to be treated is fixed and a homogenizing valve type high pressure homogenizer having a homogenizing valve. Among them, a homogenizing valve type high pressure homogenizer is preferable for the process for producing the emulsion composition according to the second embodiment since the width of the flow path of the liquid to be treated can be controlled easily, and the pressure and the flow rate during operation can be set arbitrarily, which broadens the operation range.

Further, although the degree of freedom for operation is low, the chamber type high pressure homogenizer can also be used suitably when a super high pressure is required; this is because a mechanism for increasing the pressure can be prepared easily. [0095] Examples of the chamber type high pressure homogenizer include a MICROFLUIDIZER (manufactured by Microfluidics Co.), NANOMIZER (manufacture by Yoshida Kikai Co., Ltd.), and ULTIMIZER (manufactured by Sugino Machine Ltd.).

Examples of the homogenizing valve type high pressure homogenizer include a Gaulin type homogenizer (manufactured by APV Co.), a Rannie type homogenizer (manufactured by Rannie Co.), a high pressure homogenizer (manufactured by Niro Soavi), a homogenizer (manufactured by Sanwa Machine Co. Inc.), a high pressure homogenizer (manufactured by Izumi Food Machinery Co. Ltd.), and a super high pressure homogenizer (manufactured by IKA Laboratories Co.)

[0096] In the second embodiment, the processing pressure in the high pressure homogenizer is preferably 50 MPa or higher, more preferably from 50 to 250 MPa, and further preferably from 100 to 250 MPa.

Further, from a viewpoint of maintaining the particle diameter of the dispersed particles, the emulsion liquid --- an emulsified and dispersed composition --- is preferably cooled through a cooler within 30 sec, preferably within 3 sec, from passing the chamber.

[0097] The emulsion composition obtained through the steps described above is an O/W emulsion in which emulsion particles containing the fat-soluble ingredient are dispersed in an aqueous medium.

In particular, in the second embodiment, an emulsion composition in which fine emulsion particles are dispersed uniformly can be obtained. [0098] (Particle diameter and evaluation of emulsion (-containing) composition)

The particle diameter of the emulsion particles in the first embodiment is preferably 200 nm or less from viewpoints of particle stability and transparency, and is more preferably from 5 to 100 nm from the viewpoint of transparency.

The particle diameter of the emulsion composition in the second embodiment is preferably 200 nm or less from viewpoint of particle stability and transparency, and is more preferably 130 nm or less, and is most preferably 90 nm or less from the viewpoint of transparency.

Throughout the present specification, the particle diameter refers to a volume average particle diameter unless otherwise indicated.

[0099] The particle diameter of the emulsion (-containing) composition used in the invention can be measured, for example, by a commercial particle diameter distribution measuring instrument. As a measuring method for the particle diameter distribution of the emulsion, an optical microscope method, a confocal laser microscope method, an electron microscope method, an atomic force microscope method, a static light scattering method, a laser diffraction method, a dynamic light scattering method, a centrifugal precipitation method, an electric pulse measuring method, a chromatographic method, an ultrasonic attenuation method, and the like have been known, and apparatuses corresponding to the respective principles are marketed.

In view of the particle diameter range in the invention and ease of measurement, the dynamic light scattering method is preferable for measuring the emulsion particle diameter in the present invention. Commercial measuring apparatuses using the dynamic light scattering method include NANO-TRACK UPA (manufactured by Nikkiso Co., Ltd.), dynamic light scattering type particle diameter distribution measuring instrument LB-550 (manufactured by Horiba Seisakusho Co., Ltd.), and concentrated system particle diameter analyzer FPAR-1000 (manufactured by Otsuka Electronics Co., Ltd.).

The particle diameter in the invention refers to a value measured by using a dynamic light scattering type particle diameter distribution measuring instrument LB-550 (manufactured by Horiba Seisakusho Co., Ltd.), and specifically to a value measured as described below.

In the measuring method of the particle diameter, a sample is diluted with pure water such that the concentration of the fat-soluble ingredient falls within a range of from 0.1 to 1 mass%, and measurement is conducted by using a quartz cell. The particle diameter can be determined as a median diameter at the following settings: "specimen refractive index = 1.600", "dispersion medium refractive index = 1.33 (pure water)", and "viscosity of the dispersion medium = viscosity of pure water".

The particle diameter mentioned in the invention refers to a value measured at 25°C by using the dynamic light scattering type particle diameter distribution measuring instrument.

[0100] The transmittance of the emulsion (-containing) composition according to the invention is determined by diluting the emulsion (-containing) composition with pure water such that the content of the fat-soluble ingredient becomes 0.1 mass% and measuring the transmittance at an exposure light wavelength of 700 nm using a spectrophotometer with pure water being used as a control sample.

Regarding preferable transparency, the transmittance measured by the evaluation method described above is preferably at least 80%, particularly preferably at least 85%, assuming the transmittance of distilled water as 100%. When the transmittance relative to that of distilled water is 80% or more, the emulsified particles of the emulsion (-containing) composition are sufficiently small, and the stability of the particles may be excellent. [0101] The emulsion-containing composition according to the first embodiment has pH of from 2.5 to 6.5. When the pH is 2.5 or higher, the emulsion-containing composition can exhibit, for example, a sour taste that is acceptable as a drink. When the pH is 6.5 or lower, browning of the catechin solution can be suppressed. The pH of the emulsion composition is preferably from 2.5 to 6.5, and more preferably from 3.0 to 4.5, from viewpoints of storage stability of the emulsion-containing composition, addition of sour taste to the emulsion-containing composition, and the stability of the characteristics of the emulsion-containing composition with no coagulation, precipitation, or the like. [0102] Since the emulsion-containing composition according to the first embodiment shows favorable emulsion stability and causes no coagulation in the emulsion-containing composition even when it contains a catechin, the emulsion-containing composition is preferably applied to foods and topical products. That is the food and the topical product according to the first embodiment include the emulsion-containing composition according to

the first embodiment. [0103] Examples of foods include, but are not limited to, drinks, frozen desserts, and nutrition drinks, and examples of topical products include, but are not limited to, skin

cosmetics (skin lotion, serum, milky lotion, cream, etc.), lipsticks, sunscreen cosmetics, and makeup cosmetics.

Further, the food or the topical product according to the first embodiment can be obtained, for example, by mixing the emulsion-containing composition according to the first embodiment and optional ingredient(s) that can be added for attaining desired purposes by a common method.

[0104] When the emulsion-containing composition according to the first embodiment is used as food, particularly drink, a sweetener and/or a fragrant material may be included suitably so as to render flavor or taste.

Any sweetener may be used so long as it is a material exhibiting sweet taste. For example, they include fruits juice, sugar or artificial sweetener.

The sugar includes monosaccharides such as glucose, fructose, galactose and isomerized sugar, disaccharides such as sucrose, lactose and palatinose, and oligosaccharides such as fructo oligosaccharide, isomalto oligosaccharide, galacto oligosaccharide, and palatinose, monosaccharide alcohols such as erythritol, sorbitol, xylitol, and mannitol, disaccharide alcohols such as maltitol, isomaltitol, and lactitol, trisaccharide alcohols such as maltotriitol, isomaltotriitol, and panitol, tetra- or higher- saccharide alcohols such as oligo saccharide alcohol, and sugar alcohols such as powdery reduced maltose syrup.

Examples of the artificial sweetener include stevia, aspartame, saccharin, glycyrrhizin, thaumatin, and sucralose.

[0105] Examples of the fragrant material include natural fragrant materials and synthetic fragrant materials. The natural fragrant materials include, for example, fragrant material-containing products prepared by common methods from grass roots, wood bark, flowers, fruits, fruits skins, or other animals and plants as the raw materials. The natural fragrant materials also include essential oils separated by treating natural materials by a steam distillation method, a squeezing method, or an extraction method.

The synthetic fragrant materials include, for example, fragrant materials derived from coffee, fragrant materials derived from red tea, fragrant materials derived from green tea, fragrant materials derived from oolong tea, fragrant materials derived from cocoa, fragrant materials derived from herb, fragrant materials derived from spice and fragrant materials derived from fruits.

[0106] Further, the food according to the first embodiment may be a packaged drink obtained by packing the emulsion-containing composition according to the first embodiment in a container. The container used for the packaged drink may be any container that is used usually as a container for drink. Examples thereof include PET bottles, paper packs, glass

containers, aluminum cans, and steel cans.

[0107] When the emulsion-containing composition is a food according to the first embodiment, the form of the emulsion composition may be modified in accordance with use of the food and distribution manner of the food. As such modified forms, for example, powdery forms, granular forms, and solid forms may be mentioned. When the emulsion-containing composition is modified to such a modified form, common processing means may be applied as it is. For example, processing into a powdery form may be achieved by subjecting the emulsion-containing composition according to the first embodiment in a liquid form to a drying step. Alternatively, a mixture of an emulsion composition and a water soluble or water dispersible material may be subjected to a drying step, and then a powdery, solid powdery or granular material may be mixed. The drying method to be used may be any method so long as it is used for this application, and examples thereof include spray drying, freeze-drying, vacuum drying, shelf drying, belt drying and drum drying.

[0108] As described above, the emulsion-containing composition according to the first embodiment can be used to render an antioxidant effect, an anti-inflammatory effect, a skin aging preventive effect, a whitening effect, suppression of body fats

or the like, or can be used as a food or a topical product, or can be used in combination with another food material or cosmetic material.

[0109] The emulsion composition according to the second embodiment is an emulsion composition free of coagulation of emulsion or the like and excellent in the emulsion stability even when mixed with a solution containing a polyphenol such as a catechin. Accordingly, this emulsion composition is used preferably after mixed with a solution containing a polyphenol compound. Further, occurrence of emulsion coagulation can be suppressed in the same manner also when the emulsion composition is mixed with a solution containing an organic acid such as ascorbic acid or citric acid and/or a salt thereof in addition to the polyphenol compound. Accordingly, it is also preferable to use the emulsion composition after mixing the emulsion composition with a solution containing an organic acid and/or a salt thereof in addition to the polyphenol compound.

When a mixture of the emulsion composition according to the second embodiment and the polyphenol compound or the like is used, the total amount of the polyphenol compound and the organic acid and/or the salt thereof in the obtained mixture liquid is preferably 20 mass% or less, and more preferably 10 mass% or less, with respect to the entire mixture liquid from a viewpoint of ensuring prevention of coagulation while retaining the functions deriving from the compounds.

[0110] The polyphenol compound to be used together with the emulsion composition according to the second embodiment is not particularly limited, and examples thereof include flavonoids (catechin, anthocyanin, flavon, isoflavon, flavan, flavanon rutin), phenolic acids (chlorogenic acid, ellagic acid, gallic acid, propyl gallate), lignans, curcumins, and coumarins. Further, since such compounds are contained at high contents in the extracts derived from natural products, such as those described below, they can be used in the form of extracts. [0111] Examples include licorice extracts, cucumber extracts, Mucuna birdwoodiana extracts, gentian (Gentiana triflora) extracts, Geranium thunbergii extracts, cholesterol and derivatives thereof hawthorn extracts, peony extracts, ginkgo extracts, Baikai skullcup extracts, carrot extracts, Rugosa rose (Maikai) extracts, sanpenzu (cassia) extracts, torumentila extracts, parsley extracts, Paeonia suffruticosa (Moutan Cortex.) extracts, Japanese quince extracts, Melissa extracts, ainus firma fruit extracts, strawberry geranium extracts, rosemary (mannenrou) extracts, lettuce extracts, tea extracts (oolong tea, black tea, green tea, etc.), microorganism fermentation metabolic products and Momordica grosvenorii extracts (terms in the brackets describe another name of plants and name of crude drugs). Among the polyphenols, particularly preferable ones include catechin, rosemary extracts, glucosyl rutin, ellagic acid and gallic acid.

[0112] Further, examples of the organic acid and/or salt thereof used together with the emulsion composition according to the second embodiment include L-ascorbic acid, erythorbic acid, citric acid, adipic acid, gluconic acid, succinic acid, tartaric acid, acetic acid, malic acid, lactic acid, phosphoric acid, as well as derivatives or salts thereof.

Examples of ascorbic acid, ascorbic acid derivatives, or salts thereof include L-ascorbic acid, sodium L-ascorbate, potassium L-ascorbate, calcium L-ascorbate, a L-ascorbic acid phosphate ester, a magnesium salt of a L-ascorbic acid phosphate ester, a L-ascorbic acid sulfate ester, a disodium salt of a L-ascorbic acid sulfate ester, a L-ascorbic acid stearate ester, L-ascorbic acid 2-glucoside, L-ascorbic acid palmitate ester, and L-ascorbyl tetraisopalmitate.

[0113] Examples of erythorbic acid, erythorbic acid derivatives, or salts thereof include erythorbic acid, sodium erythorbate, potassium erythorbate, calcium erythorbate, erythorbic acid phosphate ester, erythorbic acid sulfate ester, erythorbic acid palmitate ester, and erythorbyl tetraisopalmitate.

[0114] As described above, the emulsion composition according to the second embodiment shows excellent emulsion stability of the polyphenol compound even when combined with the polyphenol compound, and does not cause coagulation of emulsion. Therefore, according to the second embodiment, a method of preventing coagulation of a polyphenol compound in an

emulsion composition containing a fat-solubie material such as the polyphenol compound, is also provided.

[0115] That is, the method of preventing coagulation of the polyphenol compound according to the second embodiment is a method of preventing coagulation of the polyphenol compound in an emulsion composition including (i) a fat-soluble materia containing a polyphenol compound, (ii) a phospholipid, (iii) an emulsifier containing a sucrose fatty acid ester, and (iv) a (poly)glycerin fatty acid ester, and the method includes adjusting the ratio of the amount of the (poly)glycerin fatty acid ester

to the amount of the sucrose fatty acid ester to 0.1 or less by mass.

For the coagulation preventing method, the above descriptions given for the emulsion composition can be applied as they are.

[0116] As described above, the emulsion composition according to the second embodiment shows excellent emulsion stability even when the composition is used after mixed with a solution containing a polyphenol compound, and does not cause coagulation of the polyphenol compound; therefore, the emulsion composition is preferably applied to foods and cosmetics.

Examples of foods include, but are not limited to, drinks and frozen desert. Examples of cosmetics include, but are not limited to skin cosmetics (skin lotion, serum, milky lotion, cream, etc.), lipsticks, sunscreen cosmetics and makeup cosmetics. Examples of medicines include, but are not limited to, energy drinks and revitalizers.

Further, foods and cosmetics according to the second embodiment can be obtained, for example, by mixing the emulsion composition according to the second embodiment and one or more optional ingredients that can be added for attaining the desired purpose by a common method.

[0117] The addition amount of the emulsion composition according to the second embodiment when it is used as food or cosmetics varies depending on the type and the purpose of products, and thus cannot be defined generally. For example, the addition amount of the emulsion composition with respect to the product may be within a range of from 0.01 to 10 mass%, and preferably from 0.05 to 5 mass%. When the addition amount is 0.01 mass% or more, the desired effects can be expected. When the addition amount is 10 mass% or less, appropriate effects are likely to be obtained efficiently.

The disclosure of Japanese Patent Application No. 2007-123614 filed on May 8, 2007 and the disclosure of Japanese Patent Application No. 2007-123615 filed on May 8, 2007 are incorporated herein by reference in their entirety.

Exemplary embodiments of the present invention are described below.

<1> An emulsion-containing composition comprising: oil-in- water emulsion particles comprising a fat-soluble ingredient and an emulsifier containing a sucrose fatty acid ester, the fatty acid having less than 18 carbon atoms; and a catechin., wherein the composition has a pH of from 2.5 to 6.5.

<2> The emulsion-containing composition as described in <1>, wherein the catechin is at least one catechin selected from the group consisting of (-)-epigallocatechin-3-gallate (EGCG), (-)-epigallocatechin (EGC), (-)-epicatechin-3-gallate (ECG) and (-)-epicatechin (EC).

<3> The emulsion-containing composition as described in <1>, further comprising a polyglycerin fatty acid ester with a glycerin polymerization degree of 6 or less, wherein the fatty acid in the polyglycerin fatty acid ester has 14 carbon atoms or less.

<4> The emulsion-containing composition as described in <1>, further comprising an organic acid as an acidulant and/or a pH controller.

<5> The emulsion-containing composition as described in <4>, wherein the organic acid is at least one acid selected from the group consisting of citric acid, gluconic acid, malic acid, lactic acid and derivatives thereof.

<6> The emulsion-containing composition as described in <1>, wherein the fat-soluble ingredient further comprises a carotenoid.

<7> The emulsion-containing composition as described in <6>, wherein the carotenoid is astaxanthin and/or a derivative thereof.

<8> The emulsion-containing composition as described in <1>, further comprising an antioxidant.

<9> The emulsion-containing composition as described in <8>, wherein the antioxidant comprises at least one member selected from the group consisting of ascorbic acid, ascorbates and derivatives thereof, tocopherols, and tocotrienols.

<10> The emulsion-containing composition as described in <1>, wherein the sucrose fatty acid ester is at least one member selected from the group consisting of sucrose laurate, sucrose myristate, and sucrose palmitate.

<11> The emulsion-containing composition as described in <3>, wherein the polyglycerin fatty acid ester is hexaglycerin laurate, hexaglycerin myristate, or tetraglycerin caprylate.

<12> A food comprising the emulsion-containing composition of <1>.

<13> The food as described in <12>, wherein the food is a packaged drink obtained by packing the emulsion-containing composition in a container.

<14> A topical product comprising the emulsion-containing composition of <1>.

<15> An emulsion composition comprising a fat-soluble material, a phospholipid, an emulsifier containing a sucrose fatty acid ester, and a (poly)glycerin fatty acid ester, wherein a ratio of an amount of the (poly)glycerin fatty acid ester to an amount of the sucrose fatty acid ester is 0.1 or less by mass.

<16> The emulsion composition as described in <15>, wherein the fat-soluble material is a fat-soluble carotenoid.

<17> The emulsion composition as described in <16>, wherein the fat-soluble carotenoid is astaxanthin and/or an ester thereof.

<18> The emulsion composition as described in <15>, wherein the fatty acid in the sucrose fatty acid ester has a carbon number of from 12 to 18.

<19> The emulsion composition as described in <15>, further comprising a polyhydric alcohol.

<20> The emulsion composition as described in <19>, wherein the polyhydric alcohol is glycerin.

<21> The emulsion composition as described in <15>, wherein transmittance of light at a wavelength of 700 nm is 80% or higher when the content of the fat-soluble material is adjusted to 0.1 mass%.

<22> The emulsion composition as described in <15>, having a volume average particle diameter of 200 nm or less.

<23> The emulsion composition as described in <15>, wherein the emulsion composition is to be mixed with a solution containing a polyphenol compound.

<24> The emulsion composition as described in <15>, wherein the emulsion composition is free of a (poly)glycerin fatty acid ester.

<25> A method of preventing coagulation of a polyphenol compound in an emulsion composition containing a fat-soluble material containing a polyphenol compound, a phospholipid, an emulsifier containing a sucrose fatty acid ester, and a (poly) glycerin fatty acid ester, the method comprising: adjusting the ratio of an amount of the (poly)glycerin fatty acid ester to an amount of the sucrose fatty acid ester to 0.1 or less by mass.

EXAMPLES

[0118] In the following, the invention is described more specifically with reference to examples. In the descriptions below, "part" and "%" are on the mass basis unless otherwise specified.

[0119] Example 1

(Preparation of Emulsion Composition)

The following ingredients were dissolved for 1 hour while being heated at 70°C to obtain an aqueous phase composition.

Sucrose laurate ester (HLB=I 6) 12O g

Glycerin 63O g

Pure water 16O g

[0120] Further, the following ingredients were dissolved for 1 hour while being heated at 70°C to obtain an oil phase composition. Haematococcus algae extracts (content of astaxanthins: 20 mass%)

25 g

Lecithin (derived from soy bean) 9 g

Mix tocopherol 1 g

Coconut oil 54 g

[0121] The aqueous phase was stirred by a homogenizer (10,000 rpm) while being kept at 70°C. The oil phase was added thereto to obtain an emulsion. The thus obtained emulsion was subjected to a supersonic treatment (5 min), and then was emulsified by using ULTIMIZER HJP-25005 (manufactured by Sugino Machine Ltd.) at a pressure of 200 MPa at 60°C.

Then, this was filtered through a micro filter with an average pore diameter of 1 μm to prepare an astaxanthins-containing emulsion composition EM-OI.

Further, astaxanthins-containing emulsion compositions EM-02 to 09 were obtained in the same manner, except that the composition was changed as shown in the following Table 1.

[0122] In Table 1, as sucrose myristate ester, Ryoto Sugar Ester M-1695 (HLB=16) manufactured by Mitsubishi-Kagaku Foods Corp. was used. As sucrose laurate ester, Ryoto Sugar Ester L-1695 (HLB=16) manufactured by Mitsubishi-Kagaku Foods Corp. was used. As sucrose palmitate ester, Ryoto Sugar Ester P-1670 (HLB=I 6) manufactured by Mitsubishi-Kagaku Foods Corp. was used. Further, sucrose caproate ester had a HLB of 16, sucrose stearate ester had a HLB of 12, hexaglycerin laurate ester had a HLB of 15, and decaglycerin oleate ester had a HLB of 12. As Haematococcus extract, ASTOTS-S manufactured by Takeda Shiki Co., Ltd. was used. As lecithin (derived from soybean), RESION P manufactured by Riken Vitamin Co., Ltd. was used. As L-ascorbic acid palmitate ester, a reagent manufactured by Wako Pure Chemicals Industries Ltd. was used.

As mix tocopherol, REKEN E oil 800 manufactured by Riken Vitamin Co., Ltd. was used. As coconut oil, COCONARD MT, manufactured by Kao Co. was used.

[0123] Table 1

[0124] (Dilution)

8.1 g of citric acid (10% solution) was added to 88.44 g of pure water. 0.86 g of Pharma Foods Catechin PF-TP 80 was added thereto and 0.5 g of ascorbic acid and 0.5 g of sodium ascorbate were further added. After sufficient stirring and dissolution, 1.6 g of the obtained astaxanthins-containing emulsion composition (EM-01) was added, and the mixture liquid was stirred for 5 min with a magnetic stirrer to give an emulsion-containing composition E-01. In the same manner, E-02 to E-09 liquids were prepared. They are shown in the following Table 2.

[0125] Table 2

[0126] (Evaluation for Emulsion-Containing Composition) (1) Particle Diameter and pH

Just after preparing emulsion-containing compositions E-01 to E-09 in Table 2, pH was measured at a room temperature, and the particle diameter was measured by using a dynamic light scattering particle diameter dispersion analyzer LB-550 (manufactured by Horiba Co., Ltd.). Further, the emulsion-containing composition was placed in a glass bottle with a seal cap, left in a thermostatic oven at 50°C for 72 hours, cooled to the room temperature, and the particle diameter was again measured.

The results are shown in Table 3. [0127] (2) Evaluation of Decomposition Stability of Astaxanthins

The absorption of emulsion-containing compositions E-01 to E-09 was measured by using ND-1000 Spectrophotometer manufactured by Nano Drop Technologies, Inc. Each of water-diluted emulsions was put in nine capped glass bottles, one bottle was stored in a refrigerator (4°C). The other eight bottles were stored with time in a thermostatic oven kept at 70°C, they were taken out of the thermostatic oven one by one every hour, and stored in a refrigerator. After eight hours, they were taken out of the refrigerator, left at a room temperature for 30 min, and the absorption of the nine bottles was measured collectively. The results are shown in Table 3. [0128] (3) Evaluation of Emulsion Stability

The stability of the emulsion-containing compositions E-01 to E-09 was evaluated by visually observing the samples just after the preparation of the emulsion liquid and the samples after being left at a room temperature for 72 hours. The criteria are as described below. The results are show in Table 3. A: Coagulation or precipitates were not observed at all B: Precipitates were observed B: Suspended objects were observed B: Precipitates and suspended objects were observed

[0129] Table 3

[0130] As is apparent from Table 3, EM-01 to EM-07 --- examples according to the present invention --- were emulsion compositions which did not cause coagulation and which showed favorable store stability. [0131] Example 2

In the following, Experimental Preparation Example 1, in which an emulsion composition according to the invention was applied to drink, is shown below. However, the invention is not limited to thereto. (Experimental Preparation Example 1) (Preparation of Emulsion)

The following ingredients were dissolved for 1 hour while being heated at 70°C, to obtain an aqueous phase composition.

Sucrose laurate ester (HLB=16) 120 g

Glycerin 630 g

Pure water 160 g

Further, the following ingredients were dissolved for 1 hour while being heated at 70°C to obtain an oil phase composition.

Haematococcus algae extracts (content of astaxanthins: 20 mass%) 25 g Lecithin (derived from soy bean) 9 g

Mix tocopherol 1 g

Coconut oil 54 g

The aqueous phase composition and the oil phase composition were emulsified under high pressure as in Example 1 to prepare an astaxanthins-containing emulsion composition EM-II.

[0132] (Drink) (I) EM-II 800 mg

(2) Catechin (70% content) (PF-TP80) 300 mg

(3) Citric acid 400 mg

(4) Ascorbic acid 250 mg

(5) Sodium ascorbate 250 mg

(6) Erythritol 3500 mg

(7) Fragrant material slight amount

(8) Pure water balance

[0133] After mixing and dissolving the ingredients (2) to (8) above, the ingredient (1) was added, and further mixing was conducted. Then the volume was adjusted with pure water to prepare 50 mL drink (PH=3.5). This was filled in a bottle and sterilized under heat at 85°C

for 10 min. This was cooled to a room temperature to obtain a drink. The obtained drink was excellent in transparency and occurrence of coagulation or precipitation was not observed even after being left still at 50°C for one month.

[0134] From the above results, it was found that the emulsion-containing composition according to this example did not cause precipitation or coagulation, and showed excellent emulsion stability.

Example 3

[0135] (Preparation of Emulsion)

The following ingredients were dissolved for one hour while being heated at 70°C to obtain an aqueous phase composition.

Sucrose myristate ester (HLB=I 6) 50.0 g

Glycerin 450.0 g

Pure water 350.0 g

[0136] Further, the following ingredients were dissolved for one hour while being heated at 70°C to obtain an oil phase composition.

Haematococcus algae extracts (content of astaxanthins: 20 mass%) 37.5 g Mix tocopherol 9.5 g

Coconut oil 93.0 g

Lecithin (derived from soy bean) 10.0 g

[0137] The aqueous phase was stirred by a homogenizer (10,000 rpm) while being kept at 70°C. The oil phase was added thereto, stirred for 2 min, and cooled to a room temperature to obtain a preliminary emulsion. The obtained preliminary emulsion was emulsified at 60°C under a pressure of 200 MPa by using ULTIMIZER HJP-25005 (manufactured by Sugino Machine Ltd.).

Then, this was filtered through a micro filter with an average pore diameter of 1 μm to prepare an astaxanthins-containing emulsion composition EM-11.

Further, astaxanthins-containing emulsion compositions EM- 12 to 17 were obtained in the same manner, except that the composition was changed as shown in the following Table 4.

[0138] In the table, as sucrose myristate ester, Ryoto Sugar Ester M-1695 (HLB=16) manufactured by Mitsubishi-Kagaku Foods Corp. was used. As sucrose laurate ester, Ryoto Sugar Ester L-1695 (HLB=I 6) manufactured by Mitsubishi-Kagaku Foods Corp. was used. As sucrose palmitate ester, Ryoto Sugar Ester P- 1670 (HLB=I 6) manufactured by Mitsubishi-Kagaku Foods Corp. was used. As sucrose oleate ester, Ryoto Sugar Ester

O-1570 (HLB=15) manufactured by Mitsubishi-Kagaku Foods Corp. was used, AS decaglyceryl monooleate, NIKKOL Decaglyn 1-0 (HLB=12) manufactured by Nikko Chemicals Co. Ltd. was used. As Haematoccous extract, ASTOTS-S manufactured by Takeda Shiki Co., Ltd. was used. As mix tocopherol, REKEN E oil 800 manufactured by Riken Vitamin Co., Ltd. was used. As coconut oil, COCONARD MT, manufactured by Kao Co. was used. As lecithin (derived from soybean), RESION P manufactured by Riken Vitamin Co., Ltd. was used. [0139] (Evaluation of Emulsion)

1.0 g of the obtained astaxanthins-containing emulsion composition (any one of EM-11 to 20), 1.0 g of sodium L-ascorbate, 1.0 g of trisodium citrate and 1.0 g of catechin were added to 96.0 g of pure water and stirred for 10 min by using a stirrer. The particle diameter of the obtained emulsion dilute solution was measured by using a dynamic light scattering particle diameter analyzer FPAR-1000 (manufactured by Otsuka Electronics Co., Ltd). Further, the emulsion dilute solution was put in a glass bottle with seal cap, left in a thermostatic oven at 50°C for 1 month, cooled to a temperature, and the particle diameter was again measured. In the same manner, after leaving in a thermostatic oven at 70°C for 1 week, the particle diameter was measured.

In the evaluation described above, sodium ascorbate and trisodium citrate were reagents manufactured by Wako Pure Chemicals Industries Ltd. As catechin, PF-TP80 manufactured by Pharma Foods International Co., Ltd. was used.

The results are shown in Table 4.

[0140] Table 4

[0141] As is apparent from Table 4, EM- 11 to EM- 17 — examples according to the invention — were emulsion compositions which did not cause coagulation and which had favorable storage stability even when they were mixed with a solution containing a catechin and ascorbic acid.

[0142] Next, Experimental Preparation Examples using the emulsion composition EM-11 as examples according to the

invention are shown below, but the invention is not limited thereto.

(Experimental Preparation Example 2)

Drink

(I) EM-II 2O g

(2) Fructose liquid sugar 12O g

(3) Catechm (PF-TP 80) 5 g

(4) Vitamin C (L-ascorbic acid) 1O g

(5) Citric acid 1O g

(6) Orange fragrant matenal 3 g

(7) Water 832 g Total 1000 g

[0143] After mixing and dissolving the ingredients (2) to (7) above, the ingredient (1) was added, and further mixing was conducted to prepare a drink liquid. This was filled in a bottle and sterilized under heating at 85^{0}C for 10 min. This was cooled to a room temperature to obtain a drink. The obtained drink was excellent in transparency and occurrence of clouding, neck ring or the like was not observed even after being left still at 5O^{0}C for one month.

[0144] (Experimental Preparation Example 3) Lotion

(1) 1,3-butanediol 6O g

(2) Glycerin 40 g

(3) Oleyl alcohol 1 g

(4) Polyoxyethylene(20)sorbitane monolaurate ester

5 g

(5) Polyoxyethylene(15)lauryl alcohol ether 5 g (6) Ethanol 100 g

(7) Methyl paraben 2 g

(8) sodium L-ascorbate 1O g

(9) Catechin (PF-TP80) 1 g

(1O) EM-I i l g

(11) Purified water 775 g

Total 1000 g

[0145] Substance (1) was added to and dissolved in substance (11) to obtain an aqueous phase. Then, substances (2) to (5) and substances (7) to (9) were dissolved in substance (6), followed by stirring and mixing with the aqueous phase mentioned above. Further, substance (9) was added, and followed by stirring and mixing to obtain a lotion. The obtained lotion was excellent in transparency and occurrence of clouding was not observed even after being left still at 50^{0}C for one month.

[0146] From the above results, it was found that in the emulsion compositions of the Examples, the particle diameter of the emulsion could be made small and excellent emulsion stability was shown even when an organic acid such as sodium ascorbate and a polyphenol such as catechin were added.

Accordingly, the emulsion composition according to the invention shows excellent emulsion stability, and does not cause coagulation even when mixed with a solution containing a polyphenol compound.